

Appln No. 09/966,572
Amdt date July 19, 2004
Reply to Office action of March 19, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A positive active material for a rechargeable lithium battery comprising:

a core comprising a lithiated compound; and
at least two non-lithiated metal or metalloid oxide layers formed on the core.

2. (original) The positive active material according to claim 1, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:

$Li_xMn_{1-y}M'yA_2$ (1)

$Li_xMn_{1-y}M'yO_{2-z}X_z$ (2)

$Li_xMn_2O_{4-z}A_z$ (3)

$Li_xMn_{2-y}M'yA_4$ (4)

$Li_xM_{1-y}M''yA_2$ (5)

$Li_xMO_{2-z}A_z$ (6)

$Li_xNi_{1-y}CoyO_{2-z}A_z$ (7)

$Li_xNi_{1-y-z}CoyM''_zA_a$ (8)

$Li_xNi_{1-y-z}CoyM''_zO_{2-a}X_a$ (9)

$Li_xNi_{1-y-z}MnyM'zA_a$ (10)

$Li_xNi_{1-y-z}MnyM'zO_{2-a}X_a$ (11)

wherein:

$0.95 \leq x \leq 1.1$, $0 \leq y \leq 0.5$, $0 \leq z \leq 0.5$, $0 < a \leq 2$,

M is Ni or Co,

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M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M" is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S and P.

3. (currently amended) The positive active material for a rechargeable lithium battery according to claim 1, wherein the metal or metalloid oxide layers each range from 2×10^{-5} to 1 wt% based on the weight of the positive active material.

4. (currently amended) The positive active material for a rechargeable lithium battery according to claim 3, wherein the metal or metalloid oxide layers each range from 0.001 to 1 wt% based on the weight of the positive active material.

5. (canceled)

6. (currently amended) The positive active material for a rechargeable lithium battery according to claim 1, wherein the metal or metalloid for each metal or metalloid oxide layer is independently selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

7. (currently amended) A positive active material for a rechargeable lithium battery comprising:

a core comprising at least one lithiated compound; and

at least two non-lithiated surface-treatment metal or metalloid oxide layers formed sequentially on the core.

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8. (original) The positive active material according to claim 7, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:

$Li_xMn_{1-y}M'yA_2$	(1)
$Li_xMn_{1-y}M'yO_{2-z}X_z$	(2)
$Li_xMn_2O_{4-z}A_z$	(3)
$Li_xMn_{2-y}M'yA_4$	(4)
$Li_xM_{1-y}M''yA_2$	(5)
$Li_xMO_{2-z}A_z$	(6)
$Li_xNi_{1-y}Co_yO_{2-z}A_z$	(7)
$Li_xNi_{1-y-z}Co_yM''zA_a$	(8)
$Li_xNi_{1-y-z}Co_yM''zO_{2-a}X_a$	(9)
$Li_xNi_{1-y-z}Mn_yM'zA_a$	(10)
$Li_xNi_{1-y-z}Mn_yM'zO_{2-a}X_a$	(11)

wherein:

$0.95 \leq x \leq 1.1$, $0 \leq y \leq 0.5$, $0 \leq z \leq 0.5$, $0 < \alpha \leq 2$,

M is Ni or Co,

M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M'' is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S, and P.

9. (currently amended) The positive active material according to claim 7, wherein the metal or metalloid oxide layers each range from 2×10^{-5} to 1 wt% based on the weight of the positive active material.

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10. (currently amended) The positive active material according to claim 9, wherein the metal or metalloid oxide layers each range from 0.001 to 1 wt% based on the weight of the positive active material.

11. (currently amended) The positive active material according to claim 7, wherein the metal or metalloid for each metal or metalloid oxide layer is independently selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

12. (canceled)

13. (currently amended) A method of preparing a positive active material for a rechargeable lithium battery comprising:

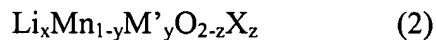
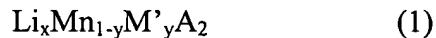
coating a lithiated compound with a first organic solution or an aqueous solution including at least one non-lithiated metal or metalloid oxide-forming compound; and

heat-treating the coated compound to form a first metal or metalloid oxide coating;

coating the lithiated compound with a second organic solution or an aqueous solution including at least one non-lithiated metal or metalloid oxide-forming compound; and

heat treating the coated compound to form a second metal or metalloid oxide coating.

14. (original) The method according to claim 13, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:



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$Li_xMO_{2-z}A_z$ (6)
 $Li_xNi_{1-y}Co_yO_{2-z}A_z$ (7)
 $Li_xNi_{1-y-z}Co_yM''_zA_a$ (8)
 $Li_xNi_{1-y-z}Co_yM''_zO_{2-a}X_a$ (9)
 $Li_xNi_{1-y-z}Mn_yM'_zA_a$ (10)
 $Li_xNi_{1-y-z}Mn_yM'_zO_{2-a}X_a$ (11)

wherein:

$0.95 \leq x \leq 1.1$, $0 \leq y \leq 0.5$, $0 \leq z \leq 0.5$, $0 < a \leq 2$,

M is Ni or Co,

M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M'' is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S, and P.

15. (currently amended) The method according to claim 13, wherein the metal or metalloid oxide layers each comprise from 0.1 to 50 wt% based on the weight of the positive active material.

16. (currently amended) The method according to claim 15, wherein the metal or metalloid oxide layers each comprise from 1 to 20 wt% based on the weight of the positive active material.

17. (currently amended) The method according to claim 13, wherein the metal or metalloid of each of the first and second metal or metalloid oxides is independently selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

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18. (currently amended) The method according to claim 13, wherein each of the organic solutions or aqueous solutions comprises at least two different metal or metalloid oxides.

19. (previously presented) The method according to claim 13, wherein at least one of the heat-treatment steps is performed at a temperature ranging from 200 to 800°C for 1 to 20 hours.

20. (previously presented) The method according to claim 13, wherein at least one of the heat-treatment steps is performed under flowing dry air.

21. (canceled)

22. (original) The method according to claim 13, wherein the coating and the heat-treatment steps are performed three or more times.

23. (currently amended) A positive active material for a rechargeable lithium battery comprising:

a core comprising a lithium-cobalt chalcogenide compound; and
at least two non-lithiated metal or metalloid oxide layers sequentially formed on the core, wherein one of the two metal or metalloid oxide layers comprises Al_2O_3 .

24. (previously presented) The positive active material of claim 23, wherein the content of Al of the metal oxide layer ranges from 2×10^{-5} to 2 percent by weight based on the weight of the positive active material.

25. (previously presented) The positive active material of claim 24, wherein the content of Al of the metal oxide layer ranges from 0.001 to 2 percent by weight based on the weight of the positive active material.

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26. (currently amended) A positive active material for a rechargeable lithium comprising:

a core comprising a lithium-manganese or lithium-cobalt chalcogenide compound; and

at least two different non-lithiated metal or metalloid oxide layers sequentially formed on the core, wherein one of the metal oxide layers comprises an oxide of B.

27. (previously presented) The positive active material of claim 26, wherein the content of B of the metal oxide layer ranges from 2×10^{-5} to 2 wt% based on the weight of the positive active material.

28. (previously presented) The positive active material of claim 27, wherein the content of B of the metal oxide layer ranges from 0.001 to 2 wt% based on the weight of the positive active material.